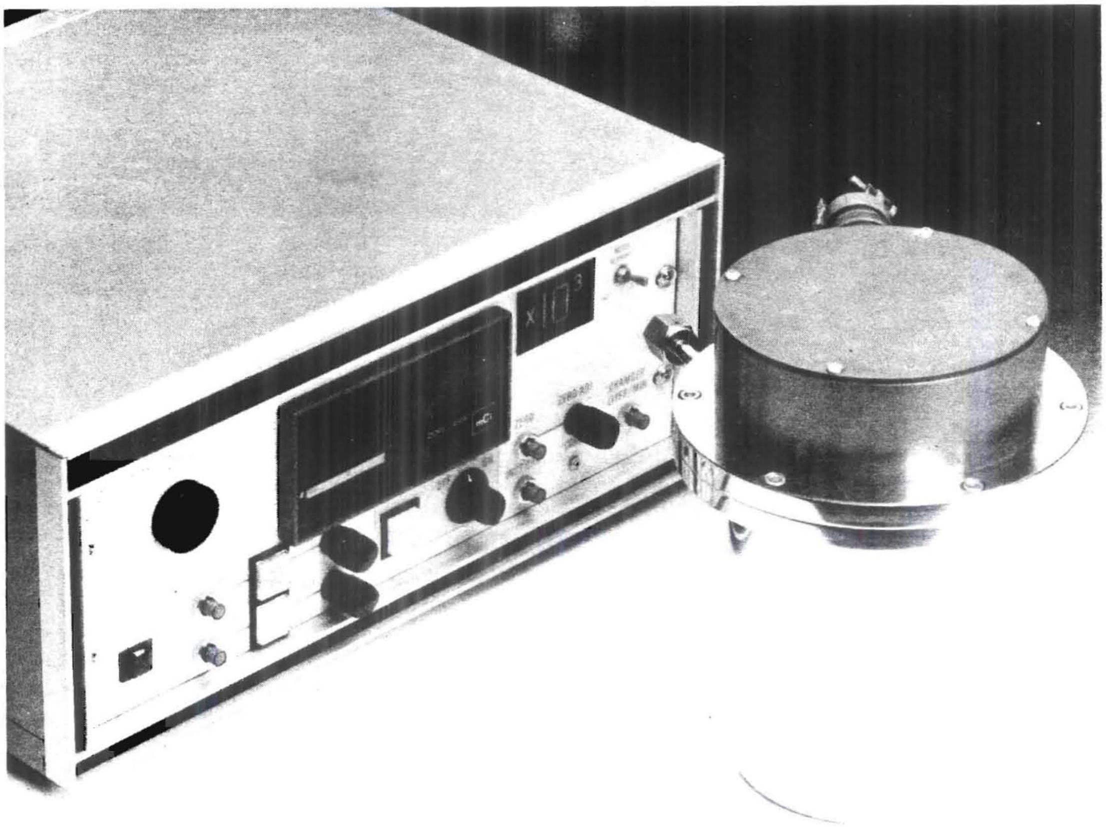
femto-TECH

INSTRUCTION MANUAL



MODEL 224GB/U24
TRITIUM MONITOR

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1. SPECIFICATIONS

Power	100 to 125 VAC, 50 to 60 Hz (no filter necessary)
Fusing	3 Amp line fuse on chassis, lights on failure
Range (Autoranging)	Range 1: 0 to 20 mCi/M^3 Range 2: 0 to 20 Ci/M^3
Resolution	Range 1: 1 μCi/M^3 Range 2: 1 mCi/M^3
Accuracy	Range 1: within ±3% of reading Range 2: within ±5% of reading
Zero Drift	Range 1: Less than ±1 μCi/M^3 per week Range 2: Less than ±1 mCi/M^3 per week
Temperature	Range 1: Stable to ±1 μCi/M^3 over range of 0°C to 50°C Range 2: Stable to ±1 mCi/M^3 over range of 0°C to 50°C
Noise	Less than ±1 μCi/M^3 (long term)
Time Constant	Two random noise discriminator modes (switch selectable). The response time in the "FAST" mode is less than 1 second to reach 66% of a step change. In the "SLOW" mode, an 18 second time constant is used below a preset level with auto-switching to "FAST" mode above this level.
Display	4-1/2 digit digital panel meter (DPM) readable at 50 ft. Analog-to-digital conversion in DPM can result in inaccuracy of ±1 LSD.
Air Flow Indication	Nominal liters/minute displayed on DPM. Intended to indicate adequate flow.
Zero Check	Electronic zero test - push button switch and digital panel meter display.
Zero Adjust	Electronic zero adjust - push button switch plus zero adjust potentiometer and digital panel meter display. To be performed with Zero Check.
Gamma/Tritium Compensation	Up to 2000 μCi/M^3 compensation for uniform gamma background or tritium contamination. Screw-driver adjust on front panel.
Potentiometer Setting Locks	"ZERO ADJ" and both alarm "ADJ" potentiometers have shaft friction locks.

SPECIFICATIONS Continued

System Test	Calibration and accuracy test of entire electrometer and readout electronics. Push button switch activated and DPM display of 13000 ±390 $\mu\text{Ci/M}^3$.
Alarms	Two audio/visual alarms with automatic reset. Set points are independent and adjustable throughout the first range.
Alarm Lockout	Automatic 90 second alarm lockout on power up and zero .
Linear Output	J2 PIN F : 0 to 10.5 VDC, $0.54\text{mV}/\mu\text{Ci/m}^3$, 5mA max J3 PIN G : 0 to 2 VDC, $0.1\text{mV}/\mu\text{Ci/M}^3$, 1MΩ (For remote DPM) J3 PIN H : 0 to 2 VDC, $0.1\text{mV}/\mu\text{Ci/M}^3$, 1MΩ (For remote DPM)
Optional Logarithmic Output	Selectable : 0 to 5 VDC logarithmic or 0 to 10 VDC linear Either selection requires optional Logarithmic Amplifier board. This output is common to both J8 and J3 PIN D.

2. OPERATING PARAMETERS

Temperature Range	0°C to 50°C
Humidity	0% to 95% r.h.
Flow Rate of Sample Gas	0 to 20 l/min. The system contains no pump. Flow rate is determined by characteristics of user supplied pump. Response time is proportional to flow rate.
Pressure	700 to 800 torr to maintain rated accuracy. Although the measurement is affected, the ion chamber can operate between vacuum and 30 psia without damage to chamber or electrometer.
Sample Gas Composition	The system is calibrated to measure tritium in nitrogen.
Installation	The ion chamber and control unit can be located up to 1000 feet apart without degradation of signal.

3. PHYSICAL DESCRIPTION

3.1 ION CHAMBER

Volume	Total : 2406 cc (±1%), Active : 1800 cc (±2%)
Fittings	Two 1/4" VCR female fittings for gas sample inlet/outlet.
Materials	All components fabricated from stainless steel with a #8 polish except for O-ring seals (Viton), electrode feed-through (Torlon), and ion chamber insulator (Torlon or Teflon). The electrometer is housed in a circular aluminum housing which is O-ring sealed to the stainless steel base plate of the ion chamber. An aluminum cover is O-ring sealed to the electrometer housing. All aluminum components are anodized.
Mounting	Ion chamber base plate contains three 1/4-20 tapped holes in a semicircle configuration for mounting to optional mounting bracket.
Weight	224GB : 13.5 lbs. , Shipping : 20 lbs.
Dimensions	See APPENDIX D

3.2 U24 CONTROL UNIT

Dimensions	U24 alone is 5.25" high x 15.5" wide x 12" deep. U24 in cabinet is 7.25" high x 17" wide x 15" deep
Weight	U24 w/cabinet : 23 lbs. , Shipping : 32 lbs

4. INTRINSIC CALIBRATION

The intrinsic calibration of the ion chamber used in the 224RM/U24 system is established by the physical size and geometry of the ion chamber and the value of the feedback resistor (high-meg). NIST traceable tritium gas standards have been used to verify the electronic calibration factor for this type ion chamber. Production ion chambers maintain the same parameters as these that have been calibrated with the tritium gas standard. Therefore, the production ion chambers have the same intrinsic calibration. The feedback resistors of each production unit are measured once by the supplier of the resistors and a second time at femto-TECH. NIST traceable standards and meters are used to perform this measurement. A built-in electronic calibration adjustment provides field adjustment and calibration verification of all electronic components back to the feedback resistor. Field calibration checks can also be performed using a fixed geometry gamma source to provide a known amount of ionization in the ion chamber. Calibration with tritium gas requires a tritium handling system and tritium gas standards for comparison.

5. INTERFACE CONNECTIONS

(J1) 14-pin connector between control chassis and ion chamber. Amphenol MS3102A-22-19P with mating MS3106A-22-19S connector on the ion chamber and Amphenol MS3102A-22-19S with mating MS3106A-22-19P connector on back of U24 chassis

A	+24 VDC
B	Common
C	-24 VDC
D	Zero Supply
E	Zero Adjust
F	Tritium Concentration Signal : 0 to 21 VDC, 1.08 mV per μCi/M^3 *
G	Range : first range = 0 VDC, second range = 24 VDC
H	Air Flow : DC voltage approximating chamber flow
J	Remote Zero : 12 VDC is applied when ZERO button is depressed
K	Instrument Check : 24 VDC is applied when INST CHK is depressed
L	Common
M	+12V VDC
N	Reserved
P	Reserved

(J2) Amphenol 10-pin connector (MS3102A-18-01S with mating MS3106A-18-01P)

A	Common
B	Common
C	Low Alarm Remote : 12 VDC sinking, alarm off = 12 VDC, alarm on = 0 VDC **
D	High Alarm Remote : 24 VDC sourcing, alarm off = 0 VDC, alarm on = 24 VDC ***
E	Low Alarm Remote : 24 VDC sourcing, alarm off = 0 VDC, alarm on = 24 VDC ***
F	Tritium Conc. Signal, Filtered : 0 to 10.5 VDC, 0.54mV/μCi/M^3, 5mA max *
G	Range Indicator : 24 VDC sourcing, 1st range = 0 VDC, 2nd range = 24VDC ***
H	Reserved
I	(or K) Purge Return : When in series with Purge Out, Purge LED is active
J	Purge Out : 24 VDC sourcing, purge off = 0 VDC, purge on = 24 VDC ***

(J3) Amphenol 8-pin connector (MS3102A-20-07S with mating MS3106A-20-07P)

A	Purge : 2 VDC sinking **
B	+12 VDC, 300 mA max
C	Common
D	Requires logarithmic amplifier board option. Jumper selectable 0 to 5 VDC logarithmic or 0 to 10.5 VDC linear tritium conc. signal *
E	Common
F	Sonalert Output : 12 VDC sinking, off = 12 VDC, on = 0 VDC **
G	Tritium Conc. Linear Meter Output #1 : 0 to 2 VDC, 0.1 mV/μCi/M^3, 1MΩ *
H	Tritium Conc. Linear Meter Output #2 : 0 to 2 VDC, 0.1 mV/μCi/M^3, 1MΩ *

(J8) BNC - This output is a parallel connection to J3 pin D

(J10) Dual female berg - 12 VDC and range indicator for T24-A Totalizer option

Notes: * while monitor is in 2nd range, signal outputs repeat the voltage span used in the 1st range, but represent 1000 times the first range value.

** all sinking outputs are capable of sinking 100mA maximum

*** all sourcing outputs are capable of supplying 20mA maximum

6. DESCRIPTION OF COMPONENTS

6.1 FRONT PANEL CONTROLS

POWER: Push-button switch. Lighted when power is on.

High Alarm READ: Push-button switch. When depressed, the high alarm set point is displayed on the DPM.

High Alarm ADJ: 10-turn potentiometer that permits setting the high alarm to any point within the first range of the monitor (high alarm is ON at any point in second range). Setting is read on the digital panel meter (DPM) only while the high alarm "READ" push button is depressed.

High Alarm ACK: Square push-button switch. When high alarm level is exceeded, the switch's backlight will flash and the sonalert will give a continuous tone. Depressing this switch silences the sonalert and forces a continuous backlight until alarm drops out.

Low Alarm READ: Push-button switch. When depressed, the low alarm set point is displayed on the DPM.

Low Alarm ADJ: 10-turn potentiometer that permits setting the low alarm to a point within the first range of the monitor (low alarm is ON at any point of second range). Setting is read on the DPM only while the low alarm "READ" push button is depressed.

Low Alarm ACK: Square push-button switch. When low alarm level is exceeded, the switch's backlight will flash and the sonalert will give an oscillating tone. Depressing this switch silences the sonalert and forces a continuous backlight until the alarm drops out.

Purge Control: 3-position rotary switch and lighted indicator. J2 pins I and J must be connected for this function to fully operate. When the switch is in the "AUTO" position and the high level alarm is energized, the purge control supplies a 24 VDC signal (J2 pins I and J) which is used to activate a high purge on a glovebox or other control function. When the switch is in the "OFF" position, there is never a 24 VDC control signal. When the switch is in the "ON" position, the 24 VDC control signal is constantly supplied.

ZERO: Push-button switch. When depressed, the system electronic zero is displayed on the DPM. The alarm circuitry is deactivated for 90 seconds after this button is pressed.

ZERO ADJ: Potentiometer that adjusts the setting of electronic zero on the DPM while zero button is depressed.

INST CHK: Push-button switch. Performs a functional check of the entire system from counting electrode of ion chamber to the DPM. It is recommended that the "ZERO" push button be depressed during this test to eliminate the addition of any output produced by ionization. A test value of 13000 ±390 $\mu Ci/M^3$ on the DPM indicates a properly functioning monitor.

COMP: Gamma compensation potentiometer (screwdriver adjustable) is provided. This is an offset voltage that can be used to cancel a constant gamma background up to the equivalent of 200 $\mu Ci/M^3$ tritium. Note that the instrument has an electronic limit of approximately -300 $\mu Ci/M^3$. Therefore, from $0 \mu Ci/M^3$, it will not be possible to observe compensation beyond this point.

CHAMBER LITER/MIN: Push-button switch. While depressed, nominal air flow through the ion chamber is displayed, in units of liters per minute, on the DPM. This is intended only to indicate adequate flow through the ion chamber.

METER RESPONSE FAST/SLOW: The switch position determines the mode of the noise discriminator. In the "SLOW" position, maximum noise discrimination is achieved. In the "FAST" position some noise (cosmic radiation, etc.) can appear on the DPM, but the time constant for the monitor is less than one second.

6.2 ION CHAMBER

The counting electrode consists of a rod with four equally spaced stainless steel fins welded around the circumference. These fins extend to within 0.75" of the chamber wall as well as to the top and bottom of the chamber. Due to this finned design, the chamber plateau voltage is a low 5 to 6 volts and the chamber operates as a flat-plate chamber at 24 volts of bias across the electrodes. The inter-electrode field geometry and gradients are such that ion recombination is suppressed, so that a better than ±3% linear response is obtained with tritium concentrations as high as 0.5 Ci/M^3. At 2 Ci/M^3 the response is down by about ±6% due to recombination. An automatic electronic correction circuit is built into the electrometer to provide linear output of better than ±5% to 20 Ci/M^3.

6.3 ELECTROMETER

The electrometer is a very high input impedance discrete amplifier located inside the top compartment of the ionization chamber. It can sense currents as low as 0.1 femto ampere. It contains all necessary circuits to sense the electron charge from the ion chamber and produce a voltage that is proportional to the tritium concentration in the ion chamber. A unique 99.996% feedback design is used so that the ionization chamber electrode is held at ground potential. This feature eliminates potential humidity problems that exist with other electrometer/ion chamber systems.

In order to eliminate several potential problems that are caused by humidity changes and electronic leakage currents, several design considerations were given to the input interface between the chamber and the field effect transistor (FET). The gate of the FET is isolated (lifted off the board) and connected directly to the center electrode and the load resistor. This eliminates all possible leakage paths in the high impedance portion of the electrometer. The use of only 24 volt biasing potential across the chamber electrodes eliminates the potential for "FET gate puncture" from high voltage spikes which are a major cause of electrometer failure.

The electrometer provides two ranges for measuring tritium concentration, with a 1000:1 ratio between ranges. This ratio is achieved by the use of the two "High Meg" feedback resistors in the system. By selecting resistor R30 to have a resistance 1000 times R1, the system can switch to a higher range when the first range is exceeded and provide over 7 decades of range. As the concentration inside the ion chamber increases, a window comparator senses the voltage of the electrometer. When the predetermined upper limit is exceeded, a solenoid physically moves the lower value resistor in parallel with the higher value resistor. At this point, as the output current of the ionization chamber keeps increasing, the electrometer can sense the concentration of the chamber without overloading the electrometer circuits. The use of the solenoid eliminates the need for relay contacts and other sources of leakage. When the second range is switched, a flag is enabled which activates the "$x10^3$" display on the front panel. This informs the operator that all values displayed on the digital panel meter are 1000 times the displayed value. In addition to the electrometer circuit, there are several other circuits on the electrometer board that support the testing and air flow monitoring functions for the ionization chamber. These circuits are described below.

Zero test: This circuit allows the operator to test and compensate for system electrical drifts. There is a solenoid on the board that, when energized, shorts the feedback resistor of the electrometer. This bypasses any tritium signals or background noise from the ionization chamber, allowing only the system offsets to register on the DPM. This zero test can be initiated from the U24 front panel by pressing the "ZERO" switch. If there is an electronic offset, the electrometer can be returned to its original null value by turning the "ZERO ADJ" control, while pressing the "ZERO" switch.

Instrument check: This circuit, when activated from the U24 front panel, injects a pre-adjusted voltage level to the input of the amplifier. The U24 DPM displays the test value. If the value is correct (13000 ±390), the complete system electronics is operating properly.

Second Range Compensation: This circuit provides electronic compensation for chamber nonlinearity due to ion recombination effects.

Air flow bias: This circuit provides the bias voltage to two thermistors that are mounted in the chamber to monitor the sampling air flow rate. Thermistor 1 is mounted in the air flow of the output tubing, while thermistor 2 is imbedded in the housing of the chamber and serves as a reference. Both thermistors are used in a bridge configuration and are heated identically at the same bias level. As the air flows through the chamber, it cools thermistor 1, offsetting the bridge. This offset is scaled and displayed, on the DPM, in units of liters per minute. This value is intended only to indicate adequate flow to the chamber.

6.4 NOISE DISCRIMINATOR

The noise discriminator is a circuit that filters unwanted noise from the electrometer and allows the monitor to operate more reliably and accurately. There are various sources of noise that the noise discriminator will filter, such as: cosmic radiation, thermal noise, electrical noise, and mechanically induced noise from the ionization chamber. In general, the noise discriminator will remove any noise signals from the output of the electrometer that have random frequency periods of less than 2.2 seconds. It contains a differential amplifier used as a precision filter for any ac signals or pulses that have a time constant of 2.2 seconds or less. However, the long time constant required to minimize noise, increases the response time of the instrument. Thus, a comparator circuit is used to switch out the high pass filter when the electrometer exceeds the maximum preset level. In addition to the discriminator circuit, this board supplies two span potentiometers for calibrated outputs for up to two remote meters.

6.5 MAIN ALARM

The main alarm board is the monitoring board for all electrometer activity. The alarm board provides audio and visual alarms, as well as support circuits for user interface. Below is a list of features provided by the main alarm board:

1. Deactivation of alarms for 90 seconds upon power-up and zero test
2. Low level alarm set point monitoring and alarm control logic
3. High level alarm set point monitoring and alarm control logic
4. Meter span calibration
5. Zero circuitry for the electrometer
6. Air flow measurement linearization circuit
7. Auto purge control logic

Upon recovery from a power failure, an automatic alarm deactivation circuit disables the alarms for a period of ninety seconds. This deactivation period is necessary in order to allow adequate electrometer settling time, before the alarms are reactivated. This feature prevents the monitor from alarming erroneously. The same alarm deactivation feature is used when the "ZERO" test for the electrometer is activated.

A window comparator is designed into the system to allow the setting of both low and high alarms to their desired levels. The low level alarm can be set by pressing the low alarm "READ" button and adjusting the "ADJ" potentiometer located to the right of the "LOW ALARM ACK" indicator of the U24 front panel. The high level alarm can be set by pressing the high alarm "READ" button and adjusting the "ADJ" potentiometer located to the right of the "HIGH ALARM ACK" indicator of the U24 front panel.

When the low alarm exceeds its preset value, the alarm board triggers the "LOW ALARM ACK" light indicator as well as the audible alarm (sonalert). Both the light and sonalert are energized in the oscillating mode and remain in this mode until the level decreases below the preset value or either "ALARM ACK" button on the front panel is pressed. When either "ALARM ACK" button is pressed, the sonalert is turned off, but the light indicator remains on until the tritium level drops below the preset alarm value.

When the high alarm exceeds its preset value, the alarm board triggers the "HIGH ALARM ACK" light indicator as well as the sonalert. The sonalert is energized in a continuous mode (the oscillating low alarm becomes continuous), and the light is energized in an oscillating mode. They remain in this mode until the level decreases below the preset value or either "ALARM ACK" button on the front panel is pressed. When either "ALARM ACK" button is pressed, the sonalert is turned off, but the light indicator remains on until the tritium level drops below the preset alarm value.

6.6 POWER SUPPLIES

±24 VDC @ 100mA, +12 VDC @ 1.7A, ±15 VDC @ 65mA

7. SYSTEM CALIBRATION

These procedures describe the process used to electronically calibrate a U24 control chassis and 224GB ion chamber system. These procedures assume that no previous set-up has taken place.

Equipment required for calibration :

- Oscilloscope
- Digital voltmeter (DVM) - 10 MΩ input impedance, 1mV to 25V range
- Variable power supply - metered 0 to 25 VDC with 1mV resolution
- Phillips screwdriver
- Slotted screwdriver
- 3/32" Allen wrench
- Wire shunt (to connect pins I & J of J2)
- Clip lead
- Complete system components:
  - U24 Chassis
  - Ion Chamber with Electrometer PC Board
  - Main Alarm PC Board
  - Noise Discriminator PC Board
  - Logarithmic Amplifier PC Board (optional)
  - 110VAC Power Cord
  - Cable (J1 of U24 to ion chamber)

Please note the following :

1) If Logarithmic Amplifier Board is to be used, cut the shunts between positions 12 & N and positions 13 & P on the underside of J6 of the U24 chassis.

2) Chassis ground is easily obtained from the silver grounding lug of the U24.

3) Always set DVM to most sensitive scale that is within range.

4) The alarms may be silenced (by pressing either "ALARM ACK" button) if they are activated during these procedures.

5) From this point on, the circuit boards will be referred to by abbreviation only. **EB**:Electrometer, **MAB**:Main Alarm, **NDB**:Noise Discriminator, **LAB**:Log Amp

PREPARE INSTRUMENT

1) With no circuit boards installed in the chassis, plug in the AC cord and turn on the instrument. Connect the DVM (-) lead to the silver hexagonal ground lug on the U24 chassis. Using the DVM (+) lead, check for the following voltages :

J1 pin A ... +24 VDC ±0.4 VDC
J1 pin C ... -24 VDC ±0.4 VDC
J1 pin M ... +12 VDC ±0.5 VDC
J7 pin 1 ... +15 VDC ±0.3 VDC
J7 pin 5 ... -15 VDC ±0.3 VDC

Turn off the instrument and unplug it.

2) With power cord DISCONNECTED, connect the cable between J1 of the U24 chassis and the ion chamber. Install a wire shunt between I & J on J2 of U24 chassis. Install the PC boards, with components facing the outside of the chassis, in the U24 chassis as follows :

Main Alarm Board (MAB) in J4
Noise Discriminator Board (NDB) in J7
Optional Logarithmic Amplifier Board (LAB) in J6

3) Using the Allen wrench, remove three of the four screws securing the blue lid of the ion chamber's electrometer housing (Leave the fourth screw loose and in the hole that has no anodizing around it). Slide the lid around to expose the electrometer.

Note : Observe that the gold shorting bar makes contact with the resistor and FET gate (the lead that is soldered to the resistor). If there is any need to adjust the shorting bar, short-out R30 by attaching one end of a clip lead to the outside end of R30 FIRST, and then attach the other end of the clip lead to the opposite end of R30 and the FET gate lead SECOND. If the MOSFET is new, it may have a thin shorting wire wrapped around its legs. If so, ensure that the FET gate lead is protected with the shorting bar and/or a clip lead, and carefully remove the thin wire from around the FET leads. It is also important the one avoids touching either of the two glass encapsulated resistors. These resistors are of extremely high resistance. Oils and other contaminants can reduce their values significantly.

4) Connect power cord and turn on the power. Allow unit to warm up for approximately 20 minutes. Connect the DVM (+) lead to the bottom resistor of RP1 on the NDB and the DVM (-) lead to chassis ground. Insure that the "RESPONSE" is set to "FAST".

5) If necessary, configure the Doric meter for no decimal point and °F. See manual (Doric 400A Digital Indicators) included with instrument.

SET ZERO AND TEST VOLTAGE

6) Using a screwdriver, adjust the gamma compensation control ("COMP" on U24 front panel) fully clockwise. The DVM should measure an increase in voltage while the "COMP" pot is being adjusted clockwise. Full clockwise position is indicated by the "feel" of the pot and no change in the DVM voltage.

7) Adjust the "ZERO ADJ" control on the U24 front panel to its midpoint position. This is 1-1/2 turns from either end point.

8) Adjust R32 on the MAB until the DVM reads 0mV ±0.5mV. It may be necessary to slightly adjust the "ZERO ADJ" control to achieve this.

9) While observing the exposed EB, press the "ZERO" button on the U24 front panel to ensure that the solenoid contacts the center electrode post.

10) While pressing the "INST CHK" button on the U24 front panel, adjust R23 on the EB until the DVM reads 14.04V ±10mV. Release the "INST CHK" button.

11) Move the DVM (+) lead to TP2 on the NDB. Adjust R4 on the NDB until the DVM reads 0mV ±0.5mV.

12) Press the "INST CHK" button for the duration of step 12. Adjust R3 on the NDB until the DVM reads 7.02V ±10mV. Move the DVM (+) lead to G of J3 on U24. Adjust R8 on the NDB until the DVM reads 1.3V ±1mV. Move the DVM (+) lead to H of J3 on U24. Adjust R9 on the NDB until the DVM reads 1.3V ±1mV. Adjust R33 on the MAB until the Doric displays 13000 ±30. Release the "INST CHK" button.

SET METER RESPONSE SWITCHING POINT

13) Put the "RESPONSE" selector in the "SLOW" position. Move the DVM (+) lead to TP3 on the NDB. Adjust R18 on the NDB until the DVM reads 25mv ±5mV (this setting determines the automatic switching point from slow to fast response). Momentarily press and release the "INST CHK" button and observe the Doric meter as the numbers decrease. The numbers should decrease relatively quickly to approximately 25, and then they should decrease at a slower rate. Return "RESPONSE" selector to "FAST".

ADJUST AIR FLOW INDICATION

14) Connect external power supply (+) lead to TP2 of MAB and (-) lead to chassis ground. Adjust the power supply voltage to 400mV ±10mV. Press the "LITERS/MIN" button on U24 and adjust R34 on the MAB until the DORIC displays 7 ±1. Remove external power supply.

15) On the EB, slide up the J2 connector so that the pins are accessible but are still making contact with the connector. Connect the DVM (+) lead to J2 of the EB and connect DVM (-) lead to chassis ground. Adjust R17 until the DVM reads 8.15V ±2mV.

16) Connect DVM (+) lead to TP2 of the MAB and adjust R16 on the EB until the DVM reads 0mV ± 1mV.

17) Repeat steps 15 & 16 until both points are within the given tolerances.

LINEARITY COMPENSATION

18) With the U24 power OFF, remove Q5 from the EB. Connect the power supply (+) lead to the cathode of CR1 on the EB and the (-) lead to chassis ground. Connect the DVM (+) lead to the collector of Q1 (leg closest to center of EB) and the (-) lead to chassis ground. Turn U24 power ON.

19) Adjust the power supply to 21.6V ±0.1V. Adjust R6 on the EB until the DVM reads 12.74V ±10mV.

20) Adjust the power supply to 10.8V ±0.1V. Adjust R7 on the EB until the DVM reads 8.14V ±10mV.

21) Repeat steps 19 & 20 until both points are within the given tolerances.

22) Leave the power supply connected and Q5 out of its socket. Decrease the power supply to 0V.

VERIFY ALARMS, RANGE CHANGE, AND PURGE

23) Press the high alarm "READ" button. Adjust the high alarm "ADJ" until the Doric reads 500 ±5.

24) Press the low alarm "READ" button. Adjust the low alarm "ADJ" until the Doric reads 50 ±2.

25) Turning the purge control knob to ON should turn on the green light. Set the purge control to "AUTO".

26) Ensure that the monitor is in the first range ("x10^3" light is off and R1 is not contacting center electrode. It may be necessary to momentarily remove the (+) lead to the power supply and ground it). Slowly increase the voltage of the external power supply. Note the point at which the low alarm is activated (flashing yellow light and oscillating sonalert). It should activate at its set point ±2 units.

27) Continue increasing the power supply voltage until the high alarm is activated (flashing red and yellow lights and steady sonalert). It should activate at its set point ±5 units. The green PURGE light should also come on at this time.

28) Continue increasing the power supply voltage until the "x10^3" light comes on and R1 of the EB is pulled into contact with the center electrode post. This point should be between 17000 μCi/M^3 and 19500 μCi/M^3. Ensure that the resistor is making contact with the center post. The alarms should still be activated.

29) Slowly decrease the voltage until the "x10^3" light turns off and the resistor is pulled back. This point should be between 5 mCi/M^3 and 15 mCi/M^3. Ensure that R1 of the EB is pulled away from the center electrode.

30) Turn the U24 power off. Remove the power supply. Reinstall Q5. Turn the U24 power ON.

VERIFY PROPER ELECTROMETER SIGNAL

31) Press "INST CHK" and adjust R23 on the EB until the monitor goes well into the second range (a couple of turns after the X10^3 light comes on and the resister pulls in). Carefully close the lid on the electrometer housing and tighten the screw to make good contact. Release "INST CHK".

32) Connect oscilloscope to the bottom of RB1 of the NDB and ground the scope to the U24 chassis ground. Set oscilloscope input for AC. Set display for 20mV/div (vertical) and 10 mS/div (horizontal).

33) Observe the oscilloscope. It should show up to 30mV of varying noise. Press "INST CHK" and the noise may change, but it should never oscillate nor be greater than 30mV. Release "INST CHK" and remove oscilloscope.

34) Open the lid of the electrometer housing. With the DVM on the bottom resistor of RP1 on the NDB, press "INST CHK" and adjust R23 (clockwise) back to 14.04V.

35) If the Logarithmic Amplifier option is NOT used, GOTO step 49

LOGARITHMIC AMPLIFIER SETUP

36) Turn the power off, remove LAB.

37) Adjust R4 on LAB to 110KΩ move JMPR 1 & 3 (if installed), install JMPR 2-2, connect power supply (+) lead to the JMPR 1-1/R4 node and (-) lead to chassis ground.

38) Install LAB, turn U24 power on.

39) Connect DVM (+) lead to TP1 of LAB and the DVM (-) lead to chassis ground.

40) Set power supply to 1mV ±0.2mV.
Adjust R3 on LAB until the DVM reads 10V ±0.2V.

41) Set power supply to 100mV ±2mV.
Adjust R5 on LAB until the DVM reads 0V ±0.2mV.

42) Set power supply to 10V ±0.2V.
Adjust R6 on LAB until the DVM reads -10V ±0.2V.

43) Repeat steps 40, 41, and 42 until all points are within the given tolerances.

44) Move the DVM (+) lead to the top pin of JMPR 2-3.

45) Set power supply to 1mV ±0.2mV.
Adjust R12 on LAB until the DVM reads 0v ±0.2mV.

46) Set power supply to 10V ±0.2V
Adjust R10 on LAB until the DVM reads 5v ±0.1V.

47) Repeat steps 45 and 46 until all points are within the given tolerances.

48) Turn power off, remove power supply and DVM, install jumpers at JMPR 1-1 and JMPR 2-2, turn power on.

49) Calibration is complete.

8. TROUBLE-SHOOTING GUIDE

*** **CAUTION** *** When the cover of the electrometer is removed, a gold shorting bar falls into place and protects the FET gate. If there is any need to adjust the shorting bar, short-out the R31 resistor by attaching one end of a clip lead to the outside end of R31 FIRST, and then attach the other end of the clip lead to the opposite end of R31 and the FET gate lead SECOND. It is also important the one avoids touching either of the two glass encapsulated resistors. These resistors are of extremely high resistance. Oils and other contaminants can reduce their values significantly.

SYMPTOM	PROBABLE CAUSE	PROBABLE SOLUTION
No display. No red light on POWER switch.	No power or blown fuse.	Check power cord If fuse light is ON, replace fuse.
No display. Red light on POWER switch is ON.	Doric DPM is unplugged.	Plug AC cord from chassis into Doric receptacle.
x10^3 light is ON, but the displayed value is greater than reasonably expected.	Second range resistor is not making contact with center electrode pin.	Carefully adjust R1 on EB to allow R1 to make good contact with center electrode pin.
Display value appears to be incorrect, but instrument passes "ZERO" & "INST CHK" tests.	Gamma "COMP" is not adjusted fully clockwise. or See note below.	Adjust Gamma "COMP" to full clockwise position. or See note below .

9. WARRANTY

Femto-TECH, Inc. warrants this product to be free of defects in workmanship and materials, and to perform per published specifications for a period of one year from shipping date, providing the unit has been properly stored, handled, and used within the specified environmental limits. This warranty is limited to repair or replacement at femto-TECH's option. Buyer assumes responsibility to apply femto-TECH, Inc. products with due regard to safety where personal injury, death, or property loss is concerned, and femto-TECH, Inc. and its employees accept no responsibility for these or other consequences. Femto-TECH, Inc. recognizes no other warranty policy than this policy as stated, regardless of the fact that orders may be accepted which attempt to bind femto-TECH, Inc. to other stipulations.

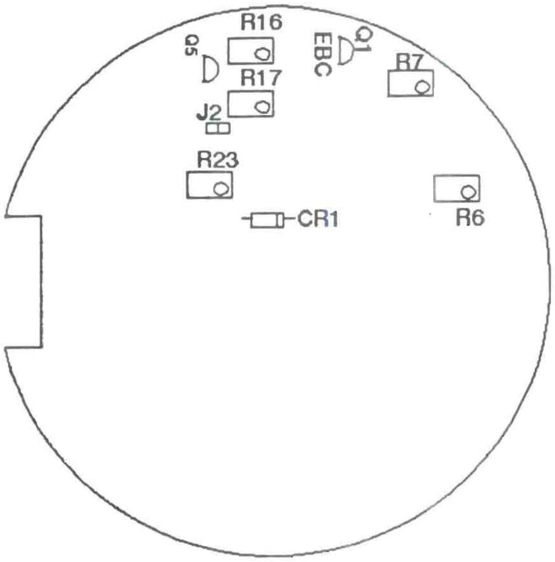
10. REPAIR POLICY

If this unit becomes defective due to workmanship or materials at any time within one year of purchase, return it to the distributor or dealer from whom the unit was purchased along with proof of purchase (sales slip, invoice, or receiving slip copy), for repair or replacement.

If the unit becomes defective beyond the one year warranty period, or was damaged due to physical abuse or attempts to operate the unit beyond its specification limits, warranty repair or replacement does not apply. However, femto-TECH, Inc. maintains a repair service which can repair and return your damaged unit in proper operating condition. Call (513) 746-4427 for current service charges.

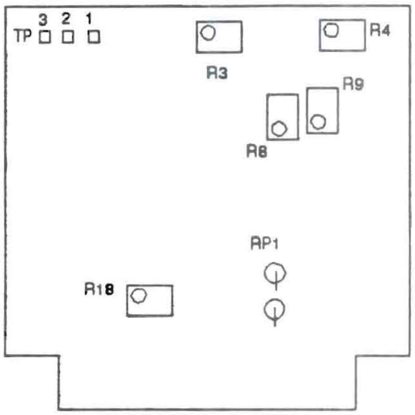
Prior to returning an instrument to the factory, the level of radioactive contamination must be determined. It may be necessary to decontaminate the instrument to ensure that it is acceptable for handling off site.

APPENDIX A
PC BOARD ADJUSTMENT/TEST POINTS



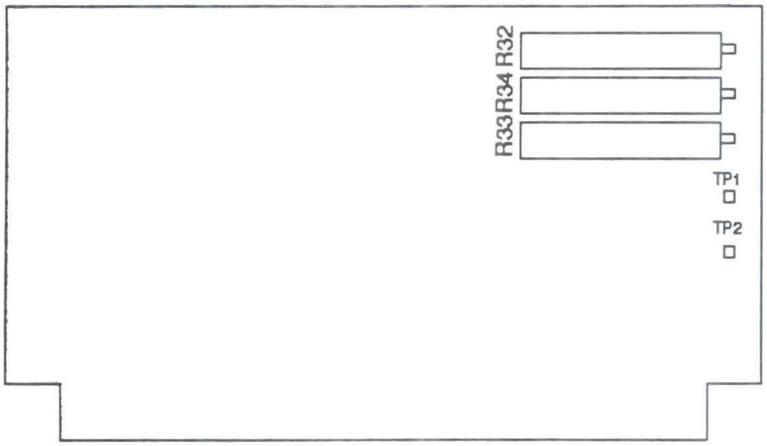
ELECTROMETER BOARD (EB)

R6,R7	2nd RANGE LINEARIZATION
R16,R17	AIR FLOW CIRCUIT BIAS
R23	INST CHK VOLTAGE ADJ



NOISE DISCRIMINATOR BOARD (NDB)

R3	GAIN ADJ
R4	OFFSET ADJ
R8	SPAN FOR J2 PIN G OUTPUT
R9	SPAN FOR J2 PIN H OUTPUT
R18	SLOW RESPONSE SET POINT ADJ

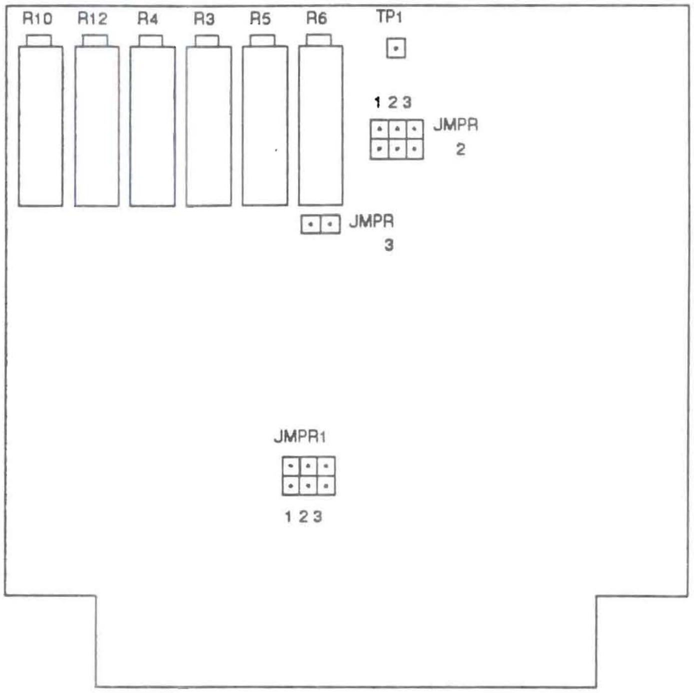


MAIN ALARM BOARD (MAB)

R32	COARSE ZERO ADJ
R33	SPAN ADJ FOR U24 DPM
R34	AIR FLOW SPAN ADJ

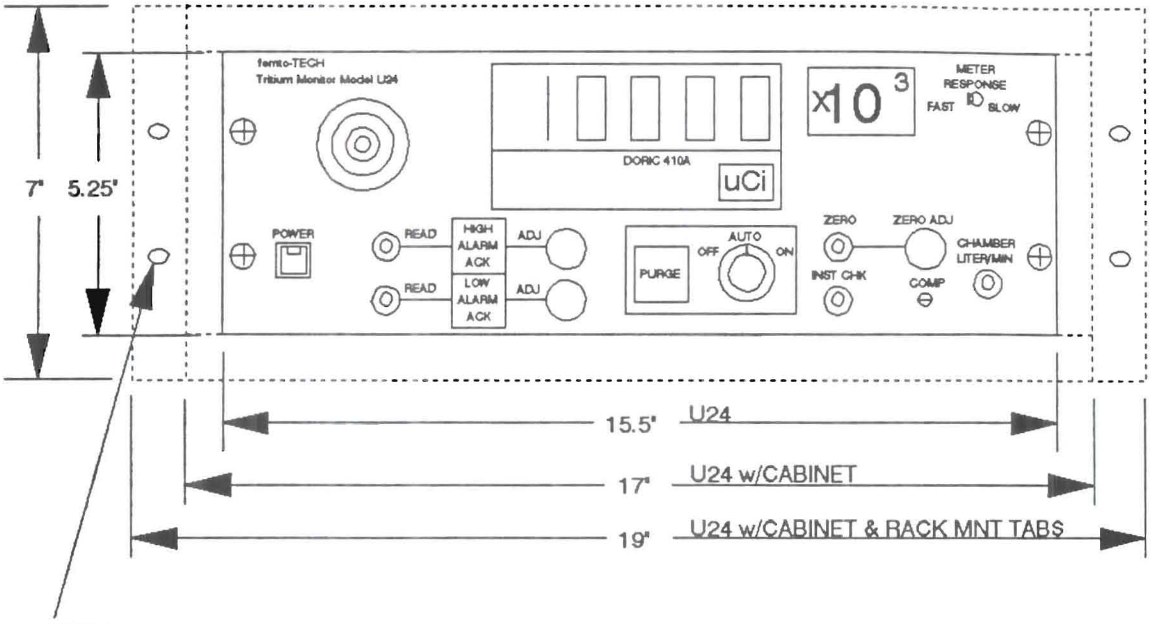
APPENDIX B

LOGARITHMIC AMPLIFIER OUTPUT SELECTION



U24 OUTPUT J8 & J3 PIN D	JMPR1	JMPR2	JMPR3
FOR 0 to 10.5 VDC LINEAR	3	3	NO
FOR 0 to 5 VDC LOG	1	2	NO

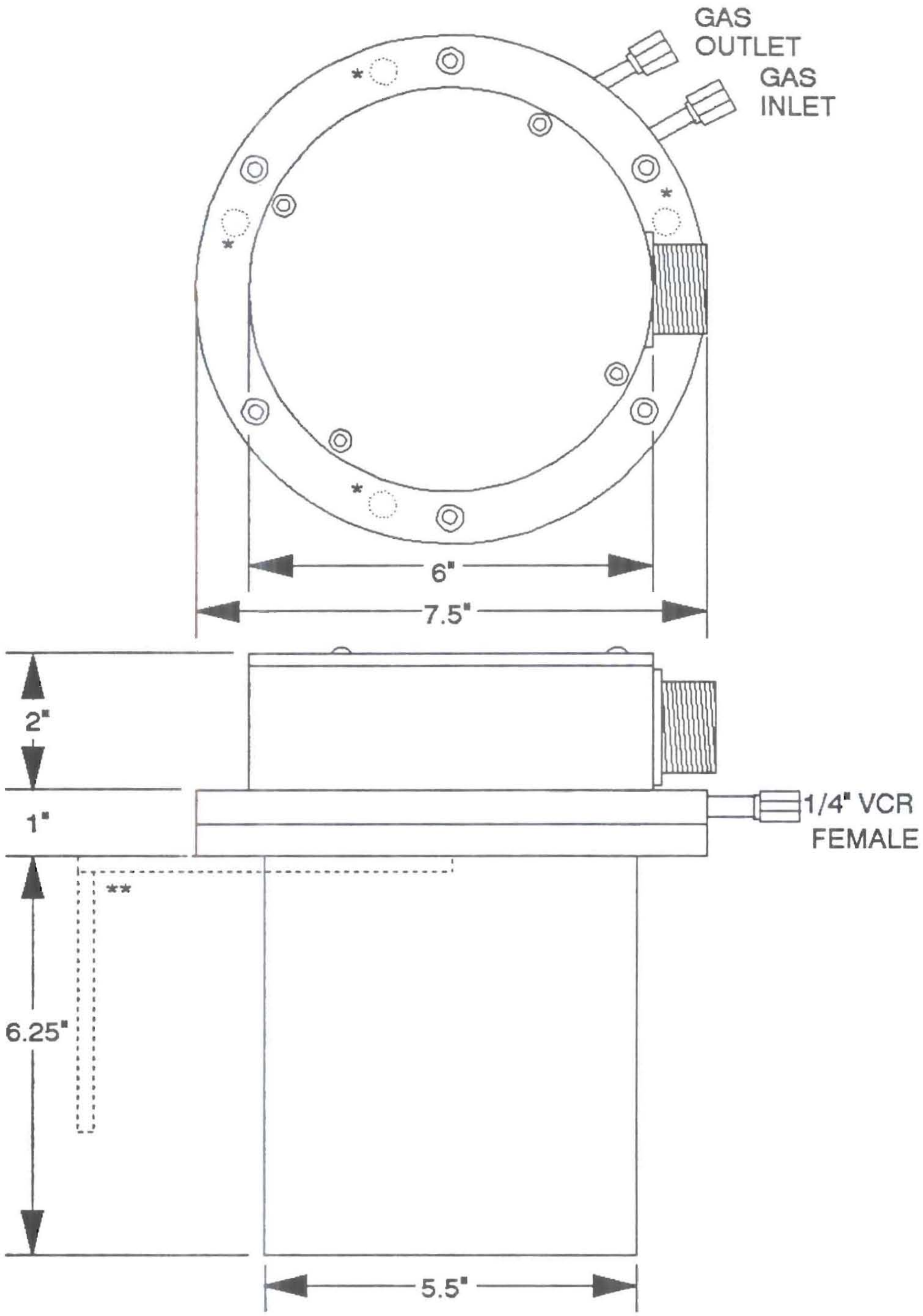
APPENDIX C
U24 CONTROL UNIT



TYP 4
HOLES ACCEPT 10-32 SCREW FOR MOUNTING TO 19" INSTRUMENT RACK

CABINET DEPTH IS 15"

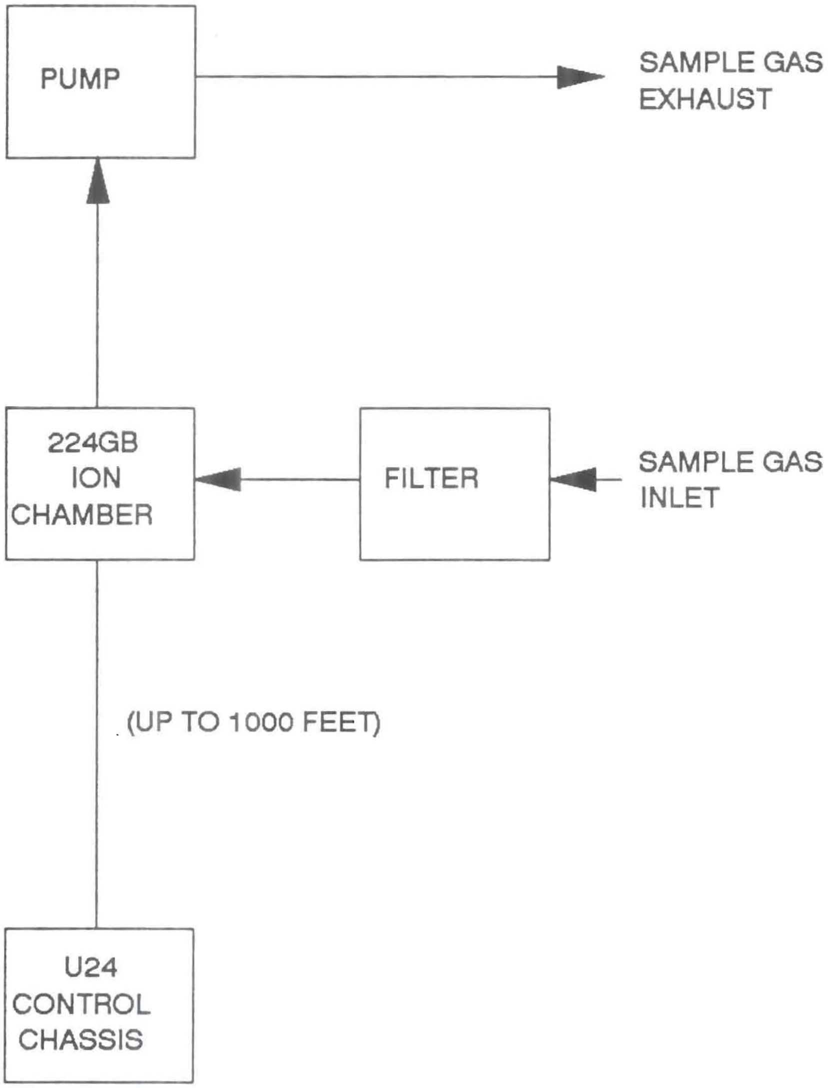
APPENDIX D
224GB ION CHAMBER



* 4 THREADED HOLES ON UNDERSIDE OF THIS PIECE FOR OPTIONAL ION CHAMBER MOUNTING BRACKET

** OPTIONAL ION CHAMBER MOUNTING BRACKET ALLOWS CHAMBER TO BE ROTATED IN HORIZONTAL PLANE

APPENDIX E
BLOCK DIAGRAM OF TYPICAL SYSTEM INSTALLATION



APPENDIX F
femto-TECH TRITIUM PRODUCTS & ACCESSORIES

femto-TECH, Inc. provides standard tritium monitors comprised of the U24 control unit and any one of the following ion chambers :

MODEL	APPLICATION	RANGE 1	RANGE 2	RESOLUTION
224GB	GLOVEBOX	0 to 20000 μCi/M^3	0 to 20000 mCi/M^3	1 μCi/M^3
224RM	ROOM	0 to 2000 μCi/M^3	0 to 2000 mCi/M^3	0.1 μCi/M^3
224DU	DUCT (PERFORATED)	0 to 20000 μCi/M^3	0 to 20000 mCi/M^3	1 μCi/M^3
2524PP	PROCESS	0 to 20000 mCi/M^3	0 to 20000 Ci/M^3	1 mCi/M^3

Note : All ion chambers, except the 224DU, are leak tested by an independent laboratory. femto-TECH provides documented certification that the ion chamber will have a leak rate of less than 10^{-7} scc/sec.

femto-TECH also provides these accessories for use with the tritium monitors:

CABINET .... (C717)	Provides total enclosure of one U24 chassis. Cabinet size is 7.25" high x 17" wide x 15" deep.
RACK MOUNT ADAPTERS .... (19-7-RMA) (Should be installed at the factory at time of purchase)	Adapts optional cabinet (above) to a standard 19" wide instrument rack. When purchased, the adapters are typically installed at the factory.
ION CHAMBER MOUNTING BRACKET ... (CMB-1)	90° blue-anodized aluminum bracket. Mounts to ion chamber via any two of the four mounting holes of the ion chamber. Allows the user to easily mount chamber to any vertical surface.
TOTALIZER .... (T-24A)	Connects to the U24. It displays an accumulated value of tritium concentration per unit of time. It also provides an RS-232C interface that allows the U24 to download information into a data acquisition system.
GAMMA COMPENSATION CHAMBER ..... (GC224) (Should be installed at the factory at time of purchase)	Provides active compensation for gamma radiation. This is used in areas where the ion chamber is exposed to varying and/or strong sources of gamma radiation while it is measuring tritium. For 224GB and 224RM models only.

APPENDIX G
SCHEMATICS & ASSEMBLY DRAWINGS

The following drawings are included :

1) U24 CHASSIS WIRING HARNESS DIAGRAM
2) U24 CHASSIS ASSEMBLY DRAWING
3) MAIN ALARM BOARD SCHEMATIC
4) MAIN ALARM BOARD ASSEMBLY DRAWING
5) NOISE DISCRIMINATOR SCHEMATIC
6) NOISE DISCRIMINATOR ASSEMBLY DRAWING
7) 224GB ELECTROMETER SCHEMATIC
8) UNIVERSAL ELECTROMETER ASSEMBLY DRAWING
9) LOGARITHMIC AMPLIFIER SCHEMATIC
10) LOGARITHMIC AMPLIFIER ASSEMBLY DRAWING

U24 Chassis Wiring Harness Diagrar

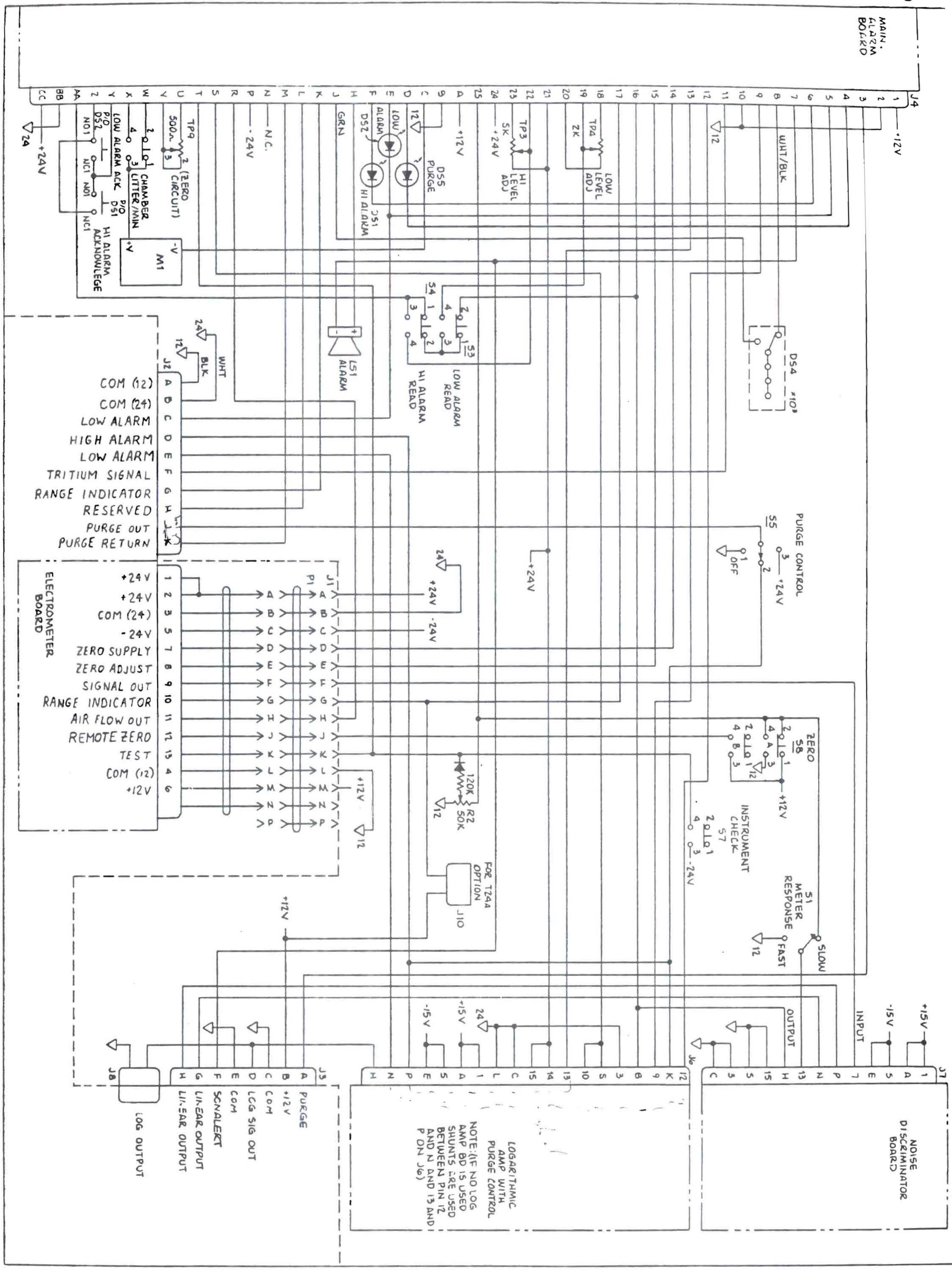


Fig. 1

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U24 Chassis Assembly Drawing

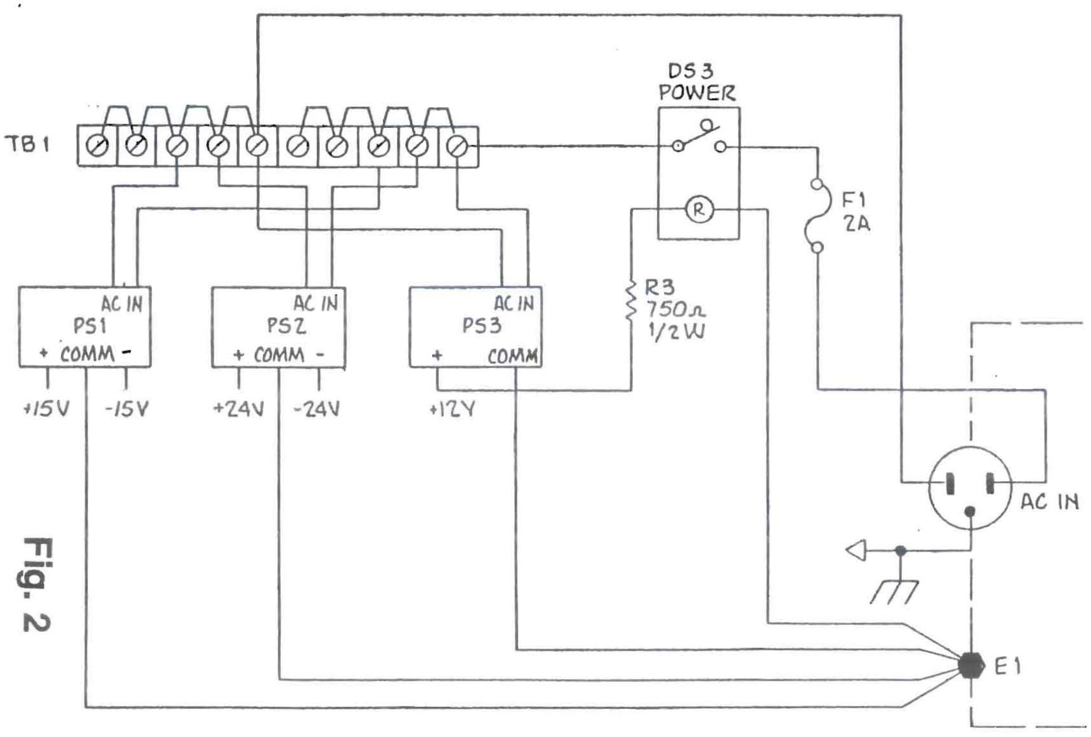
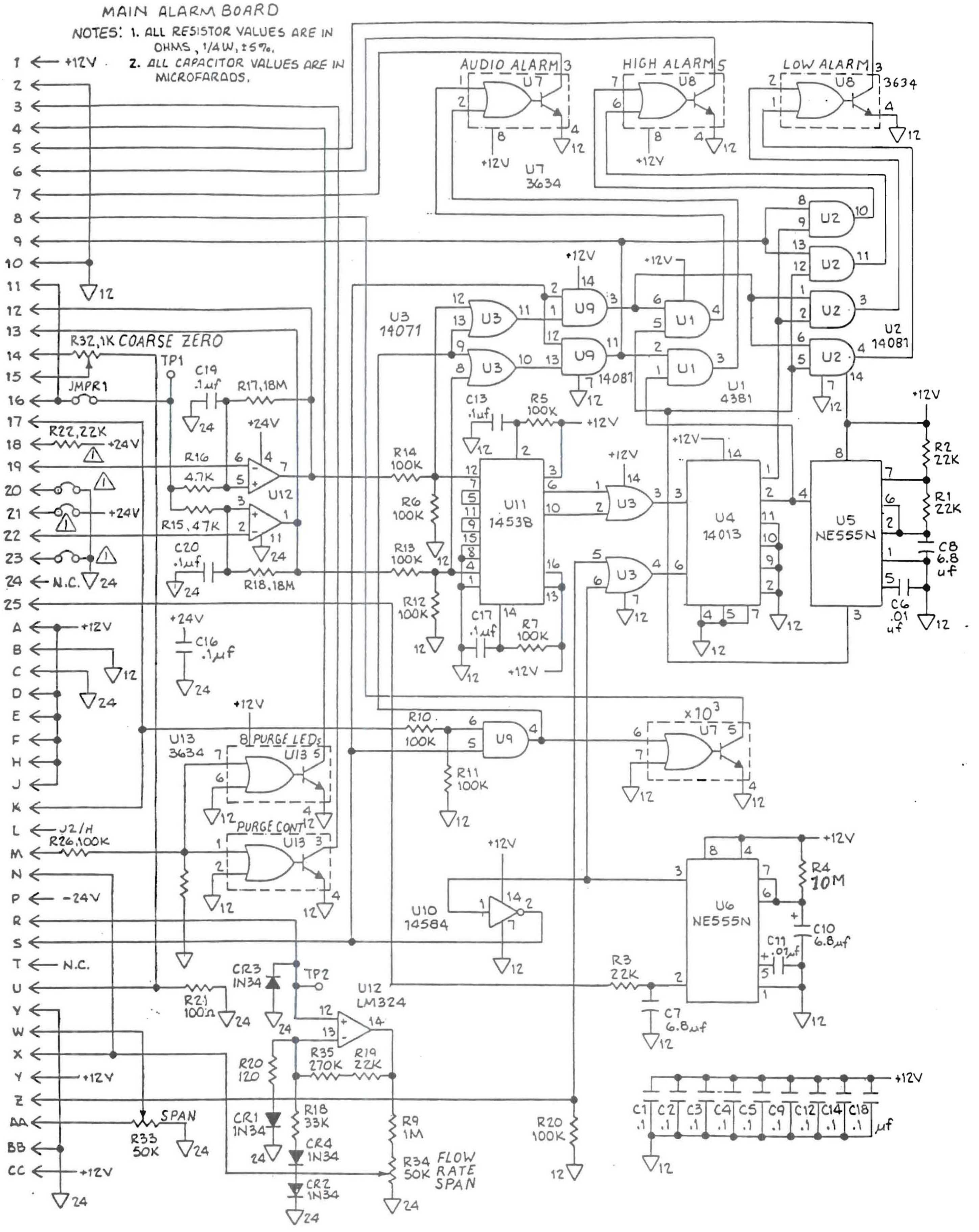


Fig. 2

RED	+24 VDC
GREEN	+12 VDC
BLACK	-24 VDC
ORANGE	12 VDC COMMON
BROWN	24 VDC COMMON
YELLOW	+15 VDC
BLUE	-15 VDC
VIOLET	+5 VDC
GREY	5 VDC COMMON
WHITE / BLACK	FRONT PANEL WIRING
WHITE / RED	14 PIN AMPHENOL
WHITE / GREEN	10 PIN AMPHENOL
WHITE / BLUE	2 PIN AMPHENOL
WHITE / YELLOW	GENERAL CHASSIS WIRING
COLOR	FUNCTION

TP9	1	3540S-1-501	POTENTIOMETER. 3 TURN, 500Ω BOURNS
TP4	1	3540S-1-202	POTENTIOMETER, 10 TURN, 2K BOURNS
TP3	1	3540S-1-502	POTENTIOMETER, 10 TURN, 5K BOURNS
R2	1	12FA4411	POTENTIOMETER, 50K SPECTROL
R3	1		RESISTOR, 750Ω, 1/2W
R1	1		RESISTOR, 1M, 1/4 W, ±5%
S5	1	PA 2001	SWITCH CENTRALAB
S3,4,	5	11-132-931-8-S3G	SWITCH EAO
6,7,8			
S1	1	LF-123	SWITCH JBT
DS3	1	8161-J86-ZQ-1-2-3	SWITCH C&K
DS2	1	A3PA-7030-15702-12E	SWITCH OMRON
DS1	1	A3PA-7030-15706-12E	SWITCH OMRON
DS5	1	A3PA-7030-15703-12E	DISPLAY OMRON
DS4	1	X10^3	DISPLAY INFO-LITE
TB2	1	8-172	TERMINAL, BARRIER CINCH
TB1	1	10-172	TERMINAL, BARRIER CINCH
PS3	1	ES-12D	SUPPLY, POWER 12V POWER MATE
PS2	1	P33-24/22690	SUPPLY, POWER 24V DUAL POLYTRON DEVICE
PS1	1	P33-1/22690	SUPPLY, POWER 15V DUAL POLYTRON DEVICE
M1	1	410-A	METER, PANEL DORIC
LS1	1	SC628	DEVICE, AUDIBLE WARNING SONALERT
	1	AGC-1	FUSE BUSS
F1	1	HKL	FUSEHOLDER BUSS
E1	1	1835	STUD, GROUND H H SMITH
1	1	EAC-301	RECEPTICAL, AC SWITCHCRAFT
J10	1	47445-000	RECEPTICAL BERG
J8	1	31-10	CONNECTOR, BNC AMPHENOL
J6,7	2	50-30A-30	CONNECTOR CINCH
J4,5	2	50-50A-30	CONNECTOR CINCH
J3	1	MS3102A-20-07S	CONNECTOR AMPHENOL
J2	1	MS3102A-18-01S	CONNECTOR AMPHENOL
J1	1	MS3102A-22-19S	CONNECTOR AMPHENOL
DET	QTY	PART NO	DESCRIPTION

Main Alarm Board Schematic



MAIN ALARM BOARD

NOTES: 1. ALL RESISTOR VALUES ARE IN OHMS, 1/4W, ±5%.
2. ALL CAPACITOR VALUES ARE IN MICROFARADS.

Fig. 3

REV. 4 2/91

NOTE:

△1 INSTALL APPROPRIATE RESISTOR VALUE FOR PROPER SCALE RESOLUTION.

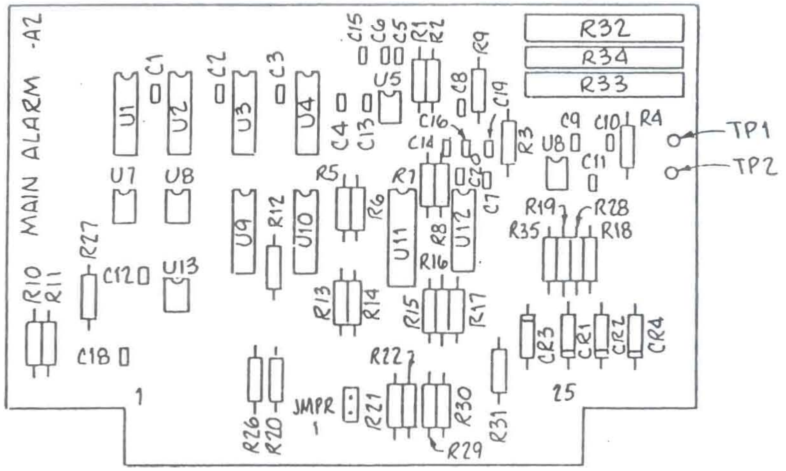


Fig. 4

DET	QTY	PART NO	DESCRIPTION
3	5	2-640463-1	SOCKET 8 PIN DIP AMP
2	8	2-640357-1	SOCKET 14 PIN DIP AMP
4	1		SOCKET 16 PIN DIP AMP
JMPR1 TP1,2	4		PIN VECTOR
U12	1	LM324N	IC, OP AMP, QUAD NATIONAL/MOTOROLA
U11	1	MC14538B	IC, VIBRATOR, DUAL MONOSTABLE MOTOROLA
U10	1	MC14584	IC, INVERTER MOTOROLA
U7,8,13	3	DS3634N	IC, DUAL CMOS NATIONAL
U5,6	2	MC1455P1	IC, TIMER MOTOROLA
U4	1	MC14013B	IC, DUAL FLIP-FLOP MOTOROLA
U3	1	MC14071B	IC, OR GATE QUAD 2 INPUT MOTOROLA
U1,2,9	3	MC14081B	IC, AND GATE QUAD 2 INPUT MOTOROLA
R4	1		RESISTOR 10M, 1/4W, ±5%
R35	1		RESISTOR, 270K, 1/4W, ±5%
R33,34	2	3059P-001-503	POTENTIOMETER, 50K BOURNS
R32	1	3059P-001-102	POTENTIOMETER, 1K BOURNS
R31	1		RESISTOR, △1, 1/4W, ±5%
R30	1		RESISTOR, △1. 1/4W, ±5%
R29	1		RESISTOR, △1. 1/4W, ±5%
R28	1		RESISTOR, 150Ω, 1/4 W, ±5%
R21	1		RESISTOR, 100Ω, 1/4W, ±5%
R18	1		RESISTOR, 33K, 1/4W, ±5%
R16	1		RESISTOR, 4.7K, 1/4W, ±5%
R15	1		RESISTOR, 47K, 1/4W, ±5%
R9	1		RESISTOR, 1M, 1/4W, ±5%
R8,17	2		RESISTOR, 18M, 1/4W, ±5%
R5,6,7, 10-14, 20,26,27	11		RESISTOR, 100K, 1/4W, ±5%
R1,2,3, 19,22	5		RESISTOR, 22K, 1/4W, ±5%
CR2-4	3	1N34A	DIODE MOTOROLA
CR1	1	1N914B	DIODE MOTOROLA
C7,8,10	3	196D685X9050PE4	CAPACITOR, TANT, 6.8µf, 50V SPRAGUE
C6,11	2	225P10391WD3	CAPACITOR, CERAMIC, .01µf, 50V SPRAGUE
C1-5,9, 12-16, 18,19,20	14	5CZ5U104X0050C5	CAPACITOR, CERAMIC, 0.1µf, 50V SPRAGUE
1	1	CM650030/A	PWB MAIN ALARM

Main Alarm Board Assembly Drawing

Noise Discriminator Schematic

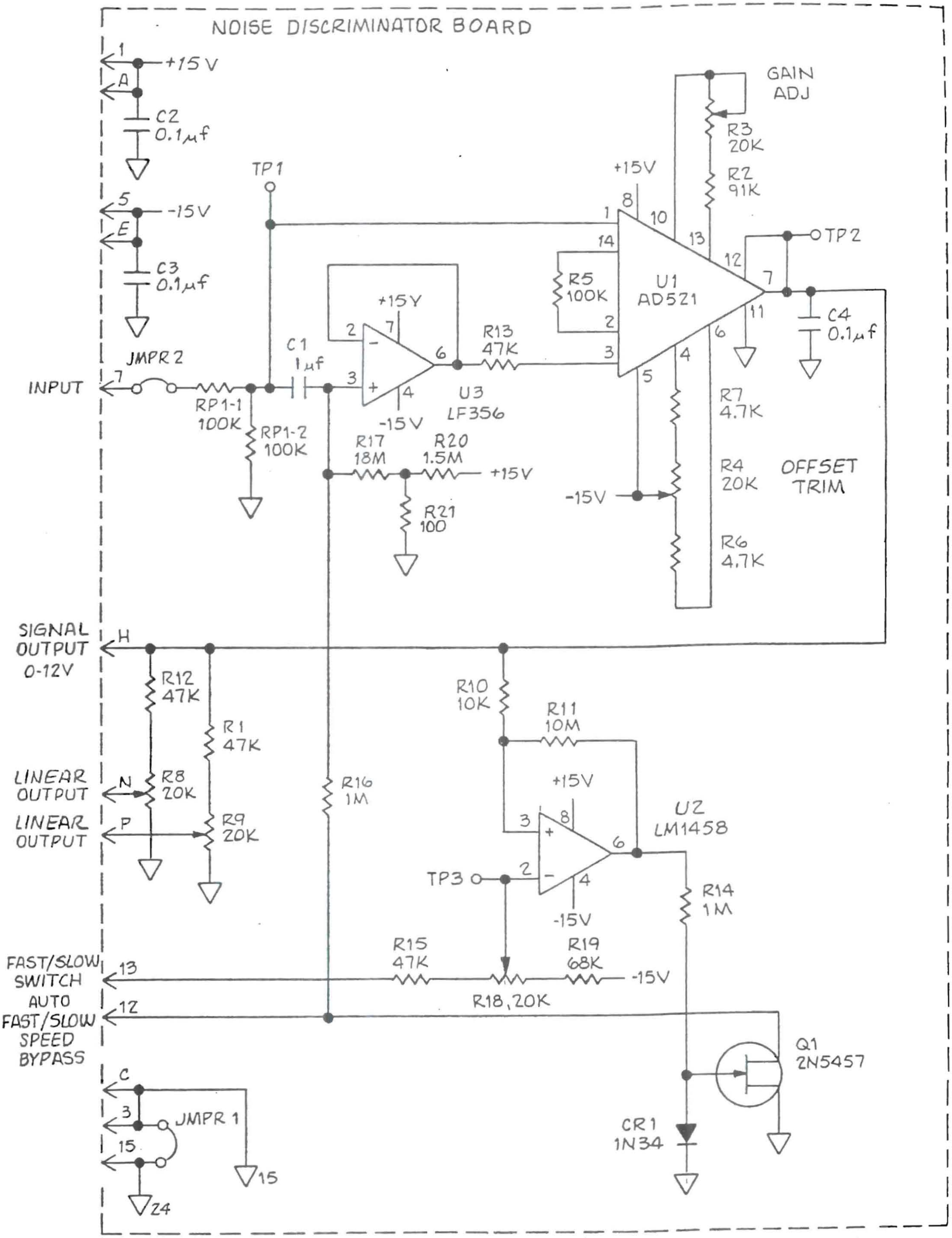
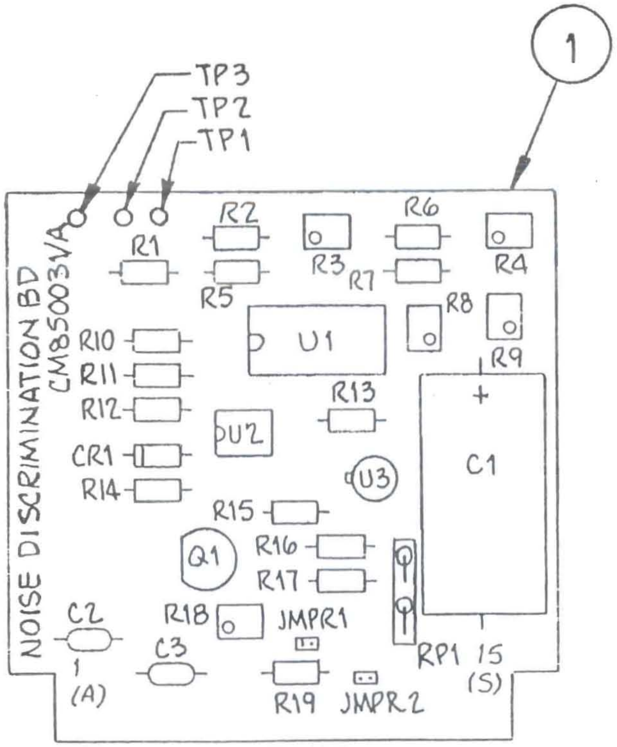


Fig. 5

Fig. 6



5	1	3-LPS-B	SOCKET, TRANSISTOR TRW
4	1	8059-2G5	SOCKET, 8 PIN TO-5 AUGAT
3	1	2-640357-1	SOCKET, 14 PIN DIP AMP
2	1	2-640463-1	SOCKET, 8 PIN DIP AMP
JMPR 1&2	2	65474-001	PLUG BERG
JMPR 1&2	7	78511-136	BERGSTIK HEADER DUPONT
TP1-3			BERG
Q1	1	2N5457	TRANSISTOR, N-CHANNEL FET, MOTOROLA
U3	1	LF356H	IC, OP AMP MOTOROLA
U2	1	LM1458N/MC1458	IC, OP AMP NATIONAL/MOTOROLA
U1	1	AD521JD	IC, OP AMP ANALOG DEVICES
R21	1		RESISTOR, 100, 1/4 W, ±5%
R20	1		RESISTOR, 1.5M, 1/4 W, ±5%
R19	1		RESISTOR, 68K, 1/4W, ±5%
R17	1		RESISTOR, 18M, 1/4W, ±5%
R14,16	2		RESISTOR, 1M, 1/4W, ±5%
R11	1		RESISTOR, 10M, 1/4W, ±5%
R10	1		RESISTOR, 10K, 1/4W, ±5%
R6,7	2		RESISTOR, 4.7K, 1/4W, ±5%
RP1,R5	3		RESISTOR, 100K, 1/4W. ±5%
R3,4,8, 9,18	5	3266W-1-203	POTENTIOMETER, 20K BOURNS
R2	1		RESISTOR, 91K, 1/4 W, ±57
R1,12, 13,15	4		RESISTOR, 47K, 1/4W, ±5%
CR1	1	1N34	DIODE MOTOROLA
C2,3,4	3	1C20Z50105M050B	CAPACITOR, CERAMIC, 0.1uf, 50V SPRAGUE
C1	1	WMF-1W1K	CAPACITOR, POLYPROPLYLENE, 1uf, 100V CDE
1	1	CM850031/A	PWB, NOISE DISCRIMINATOR BD
DET	QTY	PART NO	DESCRIPTION

Noise Discriminator Assembly Drawing

224 GB Electrometer Schematic

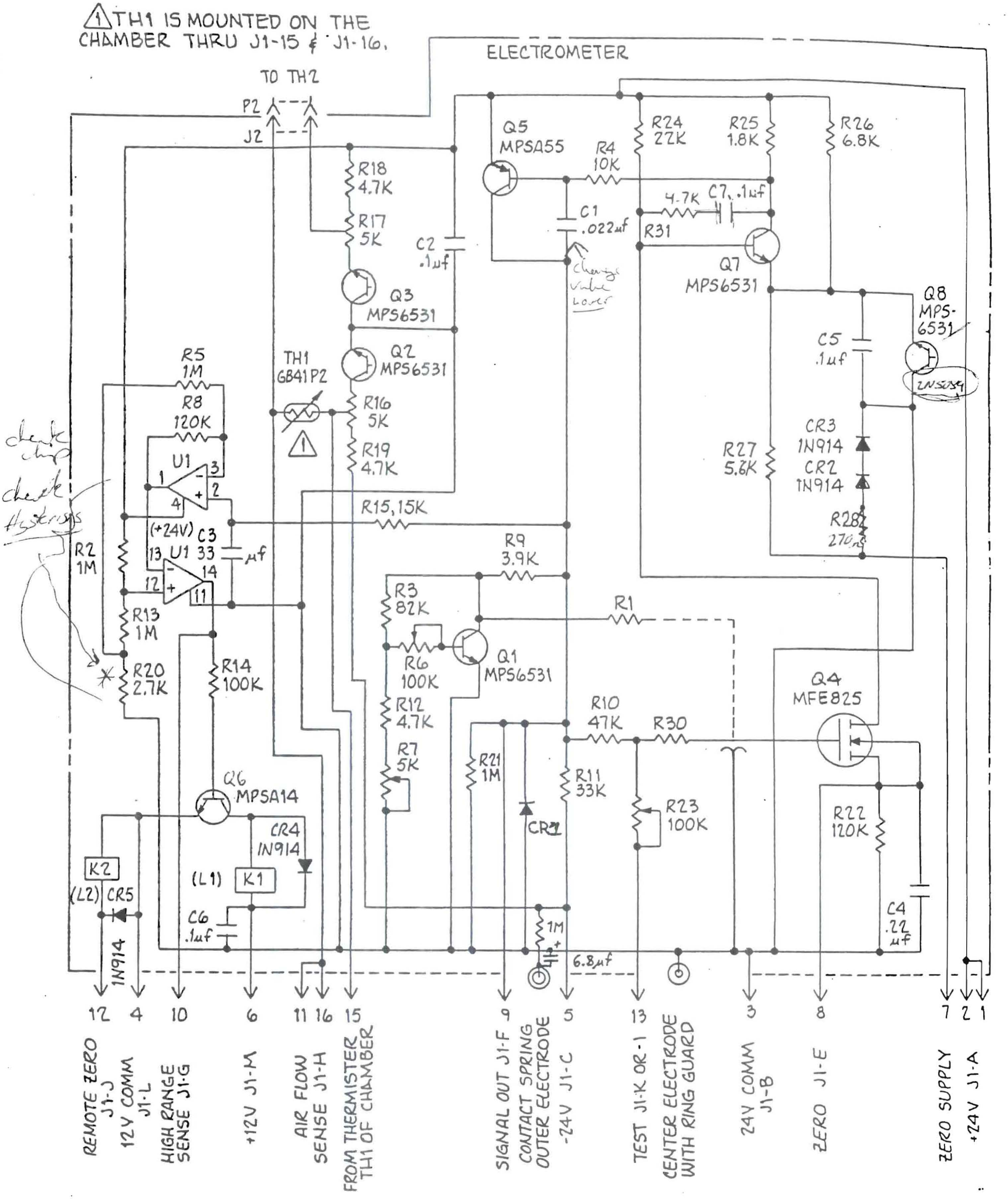


Fig. 7

NOTES:

1. SEE CHART FOR VALUE
2. THIS IS A REQUIRED PART TYPE AND MANUFACTURER AND MAY NOT BE SUBSTITUTED.
3. K2 SOLENOID PLUNGER TIED TO R30

RESISTOR SELECTION CHART

224GB	GLOVEBOX	7×10¹¹ Ω	7×10⁸ Ω
224RM	ROOM	7×10¹¹ Ω	7×10⁹ Ω
224DU	DUCT	7×10¹¹ Ω	7×10⁹ Ω
2524PP	PROCESS	1×10¹¹ Ω	1×10⁸ Ω
MODLE	TYPE	R30	R1

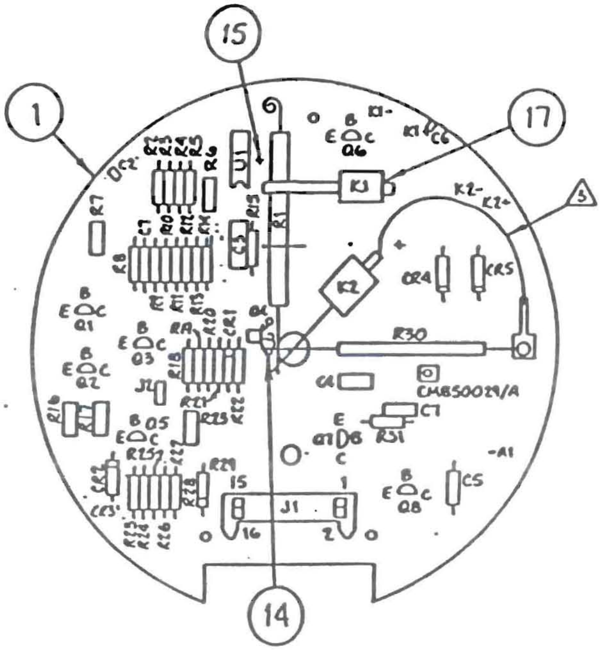


Fig. 8

DET	QTY	PART NO.	DESCRIPTION
17	4		SCREW, P.H., SS, 1-72 × 1/8
16	1	2-640357-1	SOCKET, 14 PIN DIP
15	2	T46	PIN, VECTOR VECTOR
14	2	R32/C	PIN, VECTOR VECTOR
13	1		NUT, HEX, SS, 4-40
12	1		SCREW, P.H., SS, 4-40 × 5/16
11	2		NUT, HEX, 4-40
10	1	MN440-168	SCREW, P.H., NYLON, 4-40×1
9	1		SPRING, ELECTRODE GROUNDING
8	1		TOOL, ALIGNMENT, .75×1.12 ALUM
7	1		TOOL, LEAD FORMING, 10-32×1 3/4, BRASS SCR
6	1		COUPLER, TEFLON
5	1	SPA-2H	PROBE, POGO PYLON
4	1	P2757-2-V	PROBE, POGO PYLON
3	1	S2757-2	SOCKET, POGO PYLON
2	6	3-LPS-B	SOCKET, TRANSISTOR TRW
P2	1	65474-001	PLUG BERG
J2	1	65500-102	TERMINAL, 2 CIRCUIT BERG
J1	1	3408-4405	CONNECTOR 3M, SCOTCHFLEX
TH1 2	2	GB41P2	THERMISTER FENWAL

DET	QTY	PART NO.	DESCRIPTION
K2(L2)		SP-37-12	SOLENOID, PUSH ELECTRO MECHANISM
K1(L1)		PO-37-12	SOLENOID, PULL ELECTRO MECHANISM
Q6	1	MPSA14	TRANSISTOR MOTOROLA
Q5	1	MPSA55	TRANSISTOR MOTOROLA
Q4	1	MFE825 2	TRANSISTOR MOTOROLA
Q1-3,7	4	MPS6531	TRANSISTOR MOTOROLA
Q8	1	2N5087	TRANSISTOR MOTOROLA
U1		LM324N	I.C., OP AMP NATIONAL
R30		RX-1 1	RESISTOR, -SEE CHART- VICTOREEN
R27	1		RESISTOR, 5.6K, 1/4W, ±5%
R26	1		RESISTOR, 6.8K, 1/4W, ±5%
R25	1		RESISTOR, 1.8K, 1/4W, ±5%
R24	1		RESISTOR, 22K, 1/4W, ±5%
R20	1		RESISTOR, 2.7K, 1/4W, ±5%
R15	1		RESISTOR, 15K, 1/4W, ±5%
R14	1		RESISTOR, 100K, 1/4W, ±5%
R12,18	4		RESISTOR, 4.7K, 1/4W, ±5%
19,31			
R11	1		RESISTOR, 33K, 1/4W, ±5%

DET	QTY	PART NO.	DESCRIPTION
R10	1		RESISTOR, 47K, 1/4W, ±5%
R9	1		RESISTOR, 3.9K, 1/4W, ±5%
R5,22	2		RESISTOR, 120K, 1/4W, ±5%
R7,16	3	3299W-1-502	POTENTIOMETER, 5K BOURNS
17			
R6,23	2	3299W-1-104	POTENTIOMETER, 100K BOURNS
R4	1		RESISTOR, 10K, 1/4W, 5%
R3	1		RESISTOR, 82K, 1/4W, 5%
R2,5	4		RESISTOR, 1M, 1/4W, 5%
13,21			
R1	1	RX-1 1	RESISTOR, -SEE CHART- VICTOREEN
CR2-5	4	1N914B	DIODE MOTOROLA
CR1	1	1N34	DIODE MOTOROLA
C7	1	QYX1H104KTP	CAPACITOR MYLAR 0.1uf 50V SPRAGUE
C4	1	2C3725U224	CAPACITOR, CERAMIC, 0.22uf, 50V SPRAGUE
C3	1	199D336X0035FE2	CAPACITOR, TANTALUM, 33uf, 35V SPRAGUE
C2,5,6	3	1C202SU105M050B	CAPACITOR, CERAMIC, 0.1 uf, 50V SPRAGUE
C1	1	QYX1H223KTP	CAPACITOR, MYLAR, .0022 uf, 50V NICHICON
1	1	CM850029/A	PWB, ELECTROMETER

Universal Electrometer Assembly Drawing

Logarithmic Amplifier Schematic

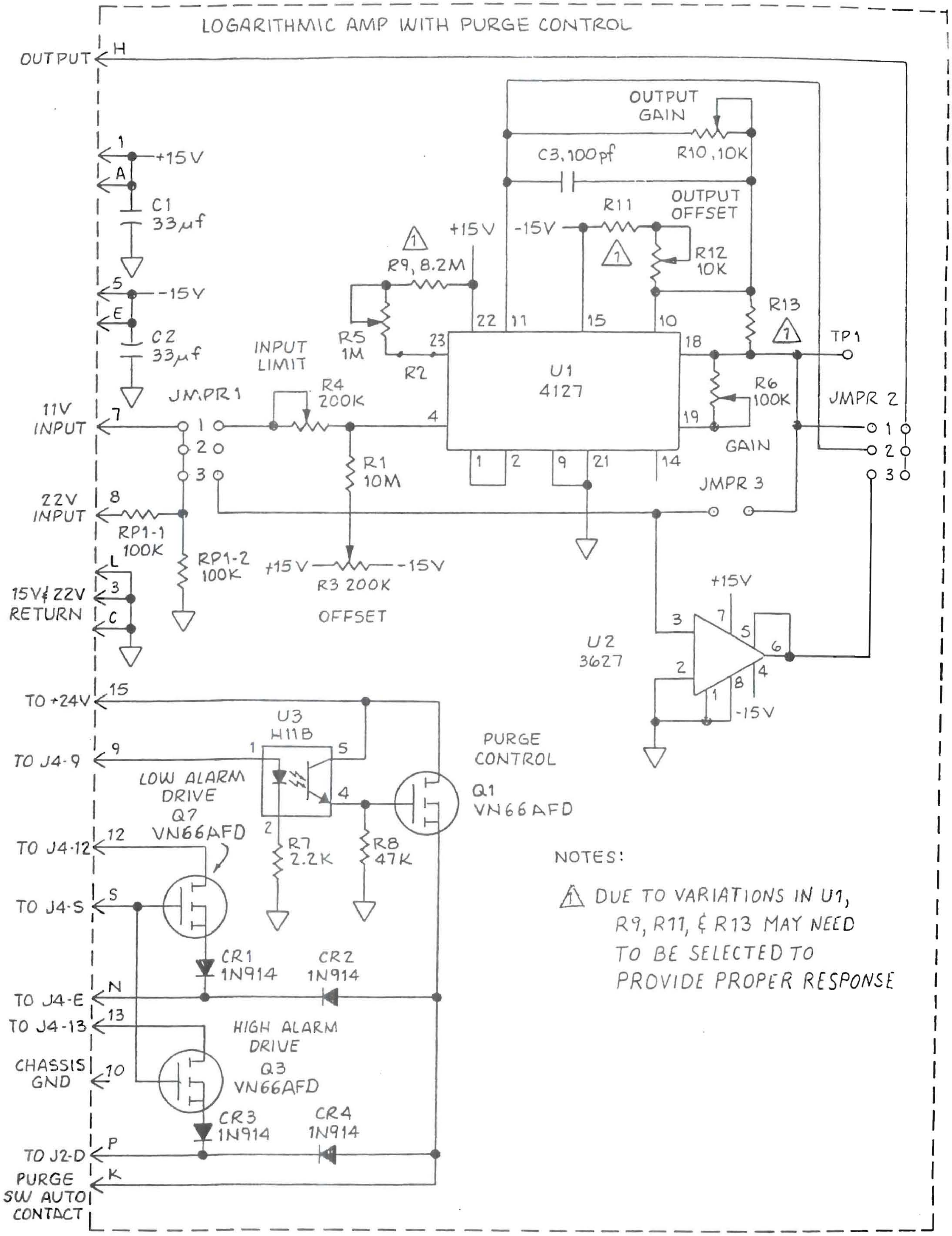


Fig. 9

Logarithmic Amplifier Assembly

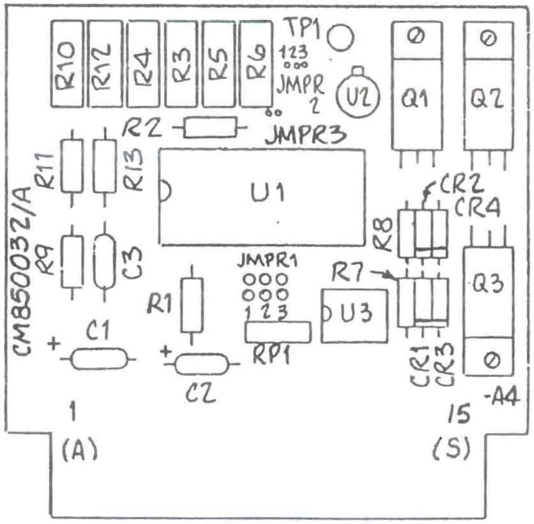


Fig. 10

JUMPER SEQUENCE CHART			
U24 OUTPUT (J8 & J3 PIN D)	JMPR1	JMPR2	JMPR3
FOR LINEAR W BUFFER	3	3	NO
FOR LOG 0-5V	1	2	NO

DET	QTY	PART NO	DESCRIPTION
4	1	8059-2G5	SOCKET. 8 PIN TO-5 AUGAT
3	1	2-641296-3	SOCKET. 6 PIN DIP AMP
2	1	2-640361-1	SOCKET. 24 PIN DIP AMP
RP1	2		RESISTOR, 100K, 1/4W, ±5%
JMPR1,2	2	65474-001	PLUG BERG
JMPR	15	78511-136	BERGSTIK HEADER DUPONT
1,2,3			
TP1			
Q1-3	3	VN66AFD	TRANSISTOR, MOSFET SILICONIX
U3	1	H11B1	IC. OPTO ISOLATOR
U2	1	3627BM	IC. OP AMP. UNITY GAIN BURR-BROWN
U1	1	4127KG	IC. LOGARITHMIC AMPLIFIER BURR-BROWN
R2	1		SHUNT
R11,13	2		RESISTOR, 22K, 1/4W, ±1%
R10,12	2	3009P-1-103	POTENTIOMETER, 10K BOURNS
R9	1		RESISTOR, 8.2M, 1/4W, ±5%
R8	1		RESISTOR, 47K, 1/4W, ±5%
R7	1		RESISTOR, 2.2K, 1/4W, ±5%
R6	1	3009P-1-104	POTENTIOMETER, 100K BOURNS
R5	1	3009P-1-105	POTENTIOMETER, 1M BOURNS
R3,4	2	3009P-1-204	POTENTIOMETER, 200K BOURNS
R1	1		RESISTOR, 10M, 1/4 W, ±5%
CR1-4	4	1N914B	DIODE MOTOROLA
C3	1	CN15A-101K	CAPACITOR, 100pf CENTRALAB
C1-2	2	VTL33535	CAPACITOR, 33uf, 25V, MALLORY
1	1	CM850032/A	PWB, LOG AMP WITH PURGE CONTROL

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